May 13, 1958 E. GUNDERT 2,834,902

DEFLECTION SYSTEM FOR CATHODE RAY TUBES

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FIG. 1.

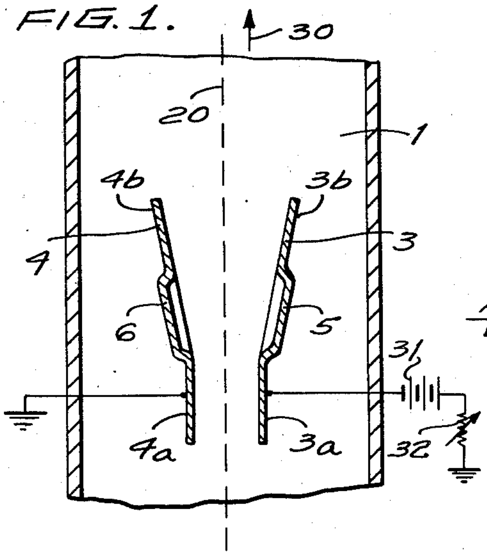
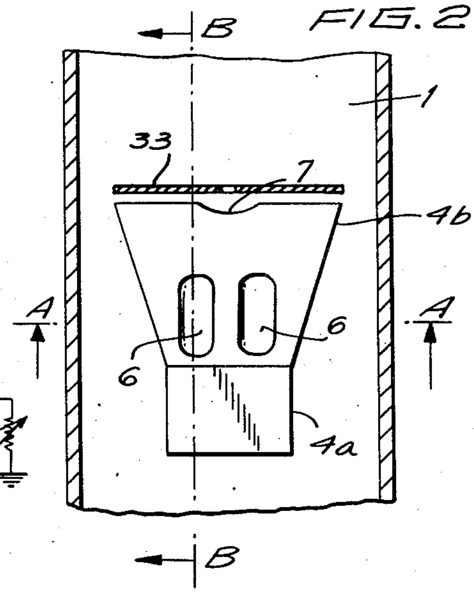


FIG. 2.



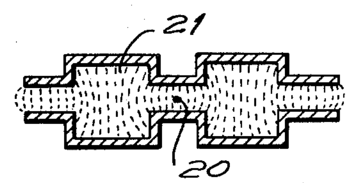


FIG. 3.

FIG. 4.

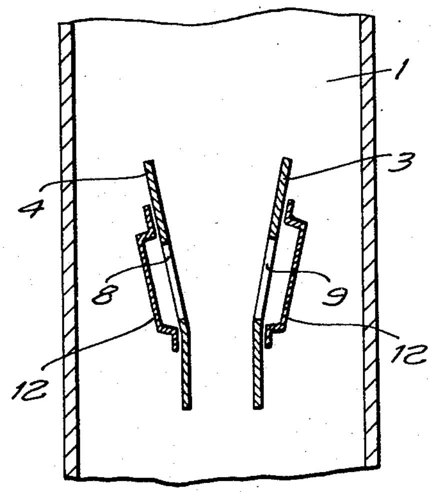


FIG. 5.

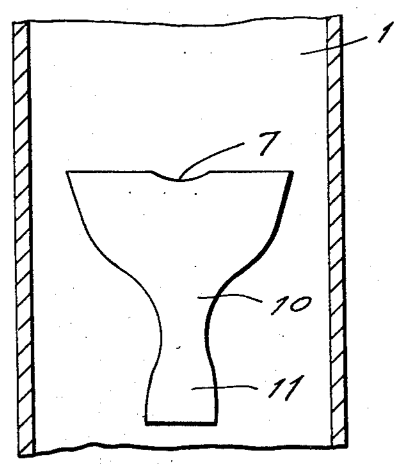


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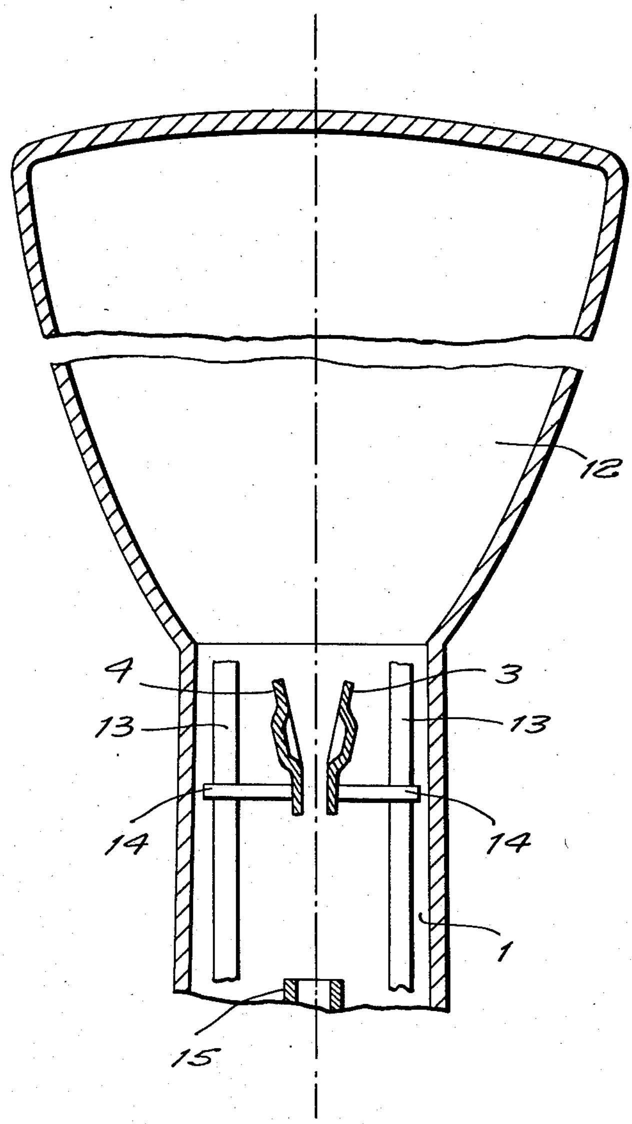
FIG. 6.



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DEFLECTION SYSTEM FOR CATHODE RAY TUBES

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7 Claims. (Cl. 313—78)

The present invention relates to electrostatic deflection systems for cathode ray tubes.

More particularly the present invention provides a new and improved method and apparatus for eliminating astigmatic distortion in cathode ray tubes using electrostatic deflection.

In cathode ray tubes using conventional electrostatic deflection systems, a deflection astigmatism of the electron beam is produced. This astigmatism shows up on the screen of the cathode ray tube where the circular spot produced by the electron beam is distorted to form an ellipse. In a two dimensional deflection field, the major axis of this ellipse is in the plane of the direction of the deflection.

To overcome this astigmatic distortion, it is necessary to construct the deflection plates so that they provide a zone of decreasing field intensity in that area where the beam is being deflected. This decreasing field intensity must be established in a plane perpendicular to the plane of the deflection.

Previous methods of overcoming this astigmatism have been primarily directed at providing the zone of decreasing field intensity at the outlet edges of the deflecting plates. Up until now these conventional methods for improving the performance of the cathode ray tubes have not been successful for use with both symmetrical and unsymmetrical deflection voltages. In the symmetrical deflection voltage system, both deflecting plates are connected to sources of potential. In the unsymmetrical deflecting system one of the plates may be grounded or directly connected to the anode of the cathode ray tube, while the other plate is connected to the deflecting voltage source.

In the present invention the deflection astigmatism is overcome by positioning the zone of decreasing field intensity between the inlet and the outlet edges of the deflecting plates and simultaneously providing a zone of uniform field intensity between the first zone and the outlet edges of the deflecting plates.

Accordingly, it is an object of the present invention to provide a new and improved electrostatic deflection system for cathode ray tubes.

A second object of the present invention is to provide a new and improved method and apparatus for eliminating deflection astigmatism in cathode ray tubes using electrostatic beam deflection.

Still another object of the present invention is to provide a new and improved combination of deflecting electric fields for beam deflection purposes in cathode ray tubes.

A further object of the present invention is to provide an improved shape for deflecting plates in electrostatically deflected cathode ray tubes.

More particularly, the present invention includes a method of preventing astigmatic distortion in a cathode ray tube using a pair of deflecting plates having inlet and outlet edges for electrostatic deflection of an electron beam passing between the plates in direction from the inlet edges to the outlet edges which comprises establishing in a first zone between the plates, spaced from the outlet edges, an electric field varying in intensity in a direction transverse to the direction of the plane of deflection of the electron beam, and establishing in a second zone between the first zone and the outlet edges an electric field of uniform intensity.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

Fig. 1 is a transverse cross-sectional view taken on the line B—B of Fig. 2;

Fig. 2 is a plan view of the neck of a cathode ray tube showing one embodiment of a deflecting plate incorporating the principles of the present invention;

Fig. 3 is a transverse cross-sectional view taken on the line A—A of Fig. 2;

Fig. 4 is a longitudinal cross-sectional view of the neck of a cathode ray tube showing a second embodiment of an electrostatic deflection system incorporating the principles of the present invention;

Fig. 5 is a plan view of a third embodiment of apparatus using the principles of the present invention; and

Fig. 6 is a cross-sectional view of a cathode ray tube showing the method of mounting deflection plates shaped in the manner of the present invention.

Referring now to Figs. 1 and 2, the neck of a cathode ray tube is shown. The dotted line **20** in Fig. 1 indicates the path of an undeflected electron beam proceeding from the cathode to the screen of the cathode ray tube in the direction of the arrow **30**.

Diametrically opposed to each other about the electron beam path **20** are two deflecting plates **3** and **4** mounted in the neck **1** of the cathode ray tube. At the inlet edges *3a* and *4a* of the deflecting plates **3** and **4** respectively, the plates are essentially parallel to one another and small in width. At the center portions of the deflecting plates **3** and **4** are re-entrant surfaces **5** and **6** respectively. The outlet edges *3b* and *4b* of the deflecting plates are at a slight angle to one another and are substantially wider than the inlet edges *3a* and *4a*.

One side of a conventional D. C. power supply **31** is shown connected to deflecting plate **3**. The other side of power supply **31** is connected to ground through a variable resistor **32**. The plate **4** is also shown connected to ground.

Upon energization of the deflecting plates from the power supply **31**, an electrostatic field is set up between the plates. The pattern of this electrostatic field is indicated in Fig. 3 by the dotted lines **21**. In Fig. 3 it can be seen that a strong electric field is established at the axis of the cathode ray tube and the path **20** of the undeflected electron beam. However, it can also be seen that the field intensity decreases between the deflecting plates in a direction transverse to the deflection plane of the electron beam.

Referring to Fig. 1 it can be seen that the electric field intensity between the deflecting plates **3** and **4** at their outlet edges *3b* and *4b* is uniform in a direction perpendicular to the deflection plane of the electron beam. The result, therefore, is the provision of an electrostatic deflection system which includes a pair of deflecting plates providing at least two zones of electric field intensity. One zone provides an electric field varying in intensity in a direction transverse to the direction of the plane of deflection of the electron beam and spaced from the outlet edges *3a* and *3b*. The other zone provides an electric field of uniform intensity and is located between the first zone and the outlet edges **3***b* and **4***b* of the deflection plates.

I have found that the above arrangement eliminates any astigmatism that is inherent in electrostatically deflected cathode ray tubes.

In Fig. 4 is shown a second embodiment of apparatus incorporating the principles of the present invention. In this embodiment, in place of the re-entrant surfaces **5** and **6**, openings **8** and **9** are provided in the plates. It is apparent that this will have an effect similar to that described above and illustrated in Fig. 3. That is, at the center portions **8** and **9** of the deflecting plates **4** and **3** respectively, the electric field intensity will decrease in a plane perpendicular to the deflecting plane of the electron beam.

In the embodiment illustrated in Fig. 4 shields **12** are provided about the openings **8** and **9**. The purpose of these shields is to prevent any of the other potentials present in the cathode ray tube from affecting the path of the electron beam.

In Fig. 5 a third embodiment incorporating the principles of the present invention is illustrated. This embodiment includes narrow inlet edges **11** of the deflecting plates and wide outlet edges **10**. It is apparent that at the center portion of the deflecting plates between the inlet edges **11** and the outlet edges **10** a decreasing field intensity is provided in a plane perpendicular to the deflecting plane of the electron beam. Near the outlet edges of the deflecting plates, however, the electric field is uniform in a plane perpendicular to the deflection plane of the electron beam.

In Fig. 6 the method of mounting deflecting plates **3** and **4** in the neck of the cathode ray tube is shown. The plates are clipped on to electrically insulated members **13** mounted within the cathode ray tube. A portion of the cathode **15** is shown to indicate the relative position of the deflecting plates with respect to the other parts of the cathode ray tube.

The embodiments described above are particularly effective when used with symmetrical deflection systems. Unsymmetrical deflection systems present an additional deflection distortion problem due to a residual astigmatism resulting from a field distortion. The field distortion in the non-symmetrical deflection system is produced by electrodes arranged near the outlet edges of the deflecting plates which are at the potential of the anode in the cathode ray tube. As a result of this field distortion the electron beam cross-section forms an ellipse due to the action of the positive deflection plate. The major axis of the ellipse is perpendicular to the direction of the deflection. This distortion of the beam can be compensated by an additional feature of the present invention which includes increasing the field intensity in a direction perpendicular to the deflection plane of the electron beam at the outlet edges of the plates.

This field intensity increase is accomplished by removing a portion of the deflection plates at the center of the outlet edge thereof. Referring to Figs. 2 and 5 the arcuate notch **7** indicates the area where a portion of the material has been removed. By this simple means it is possible to make an increasing field intensity in a direction perpendicular to the plane of the deflection of the electron beam in a non-symmetrical deflection system. This effect is achieved by the greater distance of a diaphragm **33** from the inner portion of the notch **7**.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of deflection systems differing from the types described above.

While the invention has been illustrated and described as embodied in an electrostatic deflection system for cathode ray tubes, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In an electrostatic deflection system for a cathode ray tube; a pair of deflecting plates between which the electron beam passes in direction from the inlet edges to the outlet edges of said plates, said plates having a first zone spaced from the inlet edges thereof wherein said plates are substantially planar and equidistant from the electron beam; and means combined with said deflecting plates for establishing between said first zone and said inlet edges a second zone in which the electric field varies in intensity in a direction transverse to the direction of the plane of deflection of said electron beam.

2. In an unsymmetrical electrostatic deflection system for a cathode ray tube; a pair of deflecting plates between which the electron beam passes in direction from the inlet edges to the outlet edges of said plates, said plates having a first zone spaced from the inlet edges thereof wherein said plates are substantially planar and equidistant from the electron beam, the outlet edge of each of said plates including an arcuate shaped portion symmetrically spaced with respect to the electron beam; and means combined with said deflecting plates for establishing between said first zone and said inlet edges a second zone in which the electric field varies in intensity in a direction transverse to the direction of the plane of deflection of said electron beam.

3. In an electrostatic deflection system for a cathode ray tube; a pair of deflecting plates between which the electron beam passes in direction from the inlet edges to the outlet edges of said plates, each of said plates having at least one re-entrant surface between its inlet edge and its outlet edge so as to form between said plates, spaced from the outlet edges of said plates, a zone in which the electric field varies in intensity in a direction transverse to the direction of the plane of deflection of said electron beam; and means combined with said deflecting plates for establishing between said zone of varying field intensity and said outlet edges a zone with uniform electric field intensity.

4. In an electrostatic deflection system for a cathode ray tube; a pair of deflecting plates between which the electron beam passes in direction from the inlet edges to the outlet edges of said plates; a channel cut in each of said plates between the inlet and the outlet edges thereof so as to form between said plates spaced from the outlet edges of said plates a zone in which the electric field decreases in intensity in a direction transverse to the direction of the plane of deflection of said electron beam; and means combined with said deflecting plates for establishing between said zone of varying field intensity and said outlet edges a zone with uniform electric field intensity.

5. Apparatus as claimed in claim 4 with shield members mounted adjacent each of said channels to prevent extraneous fields from affecting the path of the electron beam.

6. In an electrostatic deflecting system for cathode ray tubes including a pair of deflecting plates having an inlet and an outlet portion for the electron beam, the improvement which comprises means for establishing a zone of varying field intensity between said plates spaced from both the inlet and the outlet portions of said plates; and

means for establishing between the outlet portions of said plates a zone of uniform electric field intensity.

7. In an electrostatic deflection system for a cathode ray tube; a pair of deflecting plates between which the electron beam passes in direction from the inlet edges to the outlet edges of said plates, said outlet edges of said plates being substantially wider than said inlet edges so as to form between said plates, spaced from the outlet edges of said plates, a zone in which the electric field varies in intensity in a direction transverse to the direction of the plane of deflection of said electron beam; and means combined with said deflecting plates for establishing between said zone of varying field intensity and said outlet edges a zone with uniform electric field intensity.

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